

and the difficulty of reading without affecting their record ; but this I completely got over as explained in my "Visit to South America," 1878, by using a simple whirling table, on which the thermometers were fixed, the reading being effected by bringing them in succession under a plate of glass covering part of the circumference of the table. Nothing can exceed the simplicity of such an arrangement, which is almost independent of position, and with *small* thermometers affords a uniformity and accuracy impossible of attainment with a fixed thermometer, as it becomes a repeating instrument by a few extra turns of the table, thus insuring freedom from error of observation. I have used this system for many years with most satisfactory results.

EDWIN CLARK

Science and the Public Service

WHILST sincerely regretting the new scheme of openly cutting down the science marks in the army examinations, I think it is not so much the low maximum of marks supposed to be attainable which is discouraging the science subjects, as the low marks actually given at all Government examinations (excepting the Indian Woods and Forests) to any one who is so unwise as to take up natural science. To take, as an example, the Indian Civil Service marks of last year. While in French and German, each of which is a 500 subject, more than 30 per cent. of the candidates obtained over 200 marks ; in chemistry, which is also a 500 subject, only two out of thirty-two, or 6 per cent., scored over 200. The marks in the other subjects included in the fatal column of natural science are equally low. Now I do not think that any one will maintain that science is not properly taught at Clifton, Dulwich, &c., yet in French and German a boy has every chance of obtaining 100 marks more than in chemistry (the highest marks last year were—chemistry 229, French 325, German 347). Two possibilities present themselves : either the clever boys will not take up science subjects at all owing to the low marks persistently given, or the examiners expect more chemical knowledge from a boy of eighteen (who must take mathematics or classics, English, &c., in addition to chemistry) than he can possibly acquire. I trust that examiners may be induced to seriously consider the last possibility.

F. C. S.

THE ROYAL CORPS OF NAVAL CONSTRUCTORS

BY an Order in Council of August last this corps was established ; an Admiralty Circular of November last published the details of the new arrangements ; and the result of the first examination for the grade of "Students in Naval Construction" has recently been announced. An important change has thus been made in the entry, training, and promotion of the professional officers upon whom devolve the responsibilities connected with the design and construction of ships for the Royal Navy ; yet little public interest has been evinced. There can be no dispute, of course, as to the great importance attaching to the maintenance in the highest state of efficiency of the constructive department of the navy. Shipbuilding is making such rapid strides that all who have to take part in its developments, whether for war or for commerce, require a highly scientific as well as a thoroughly practical education, if they desire to keep in the forefront of progress. And for modern war-ships with their high speeds, heavy burdens of armour and armament, and liability to damage in action, specially difficult problems continually present themselves, the solution of which is only possible by means of scientific procedure. Recognising these facts, it may be well to make a brief statement respecting the new Constructive Corps, and to indicate the manner in which its creation may be beneficial not merely to the public service but to the mercantile marine.

It is only proper to remark at the outset that the Lords Commissioners of the Admiralty have hitherto been the chief patrons of the scientific education of shipbuilders in England ; and to their generosity has been due the existence of the only establishments in which the higher train-

ing of naval architects was provided for. Early in the present century (1811) the first School of Naval Architecture was established in Portsmouth Dockyard, and continued at work for more than twenty years. It was established in consequence of the absolute necessity for opposing to the well-trained French naval architects men of equal education and ability, who could not be found at that time in our naval service. Ship-designing was clearly in a very inferior position here, when no shame was felt in building servile imitations of vessels captured from the French. In 1832 this school was abolished, and for sixteen years there was no training establishment of the kind open for English students. But during that interval men educated at Portsmouth occupied important positions both in the Royal Naval service and in private establishments, helping to maintain our national reputation. In 1848 a second school was opened at Portsmouth, on a much more modest scale, and destined to have a shorter life, for it lasted only five years. That brief period sufficed, however, to produce a number of men still holding some of the highest positions in the profession. Another interval of ten years elapsed, and then the Royal School of Naval Architecture was opened at South Kensington, the Admiralty giving it large support, although it aimed at educating other than Admiralty students. Since 1864 there has been no interruption in the good work, although in 1873 the establishment at Kensington was broken up, and the Admiralty section of it transferred to the Royal Naval College at Greenwich. There, as at Kensington, all comers are welcomed if they possess sufficient preliminary training, and private English students, as well as foreigners, have opportunities for instruction afforded them as good as those which the Admiralty provide for their own students. By the munificence of Mrs. John Elder the University of Glasgow has had a Professorship of Naval Architecture recently established, and the classes will, it is understood, commence work this year. But up to the present time the Royal Naval College affords unrivalled opportunities for instruction, and may challenge comparison with any similar institution in Europe.

By means of the very excellent training schools in the Royal dockyards, and the large field of selection from among the apprentices, the Admiralty have been able to secure a continuous supply of well-prepared students for the higher training at Kensington or Greenwich ; and thus have obtained the educated naval architects required for the public service. Nor is this all that has been done. A very considerable number of the trained men have passed from Admiralty employment into private establishments, where they have done and are doing good work.

It may be asked, in view of these results, why change a system which has worked so well? The answer is twofold. First, there were grave objections to the continuance of the restrictions imposed by the regulations for first entry into the service. Second, there was not proper recognition of the special training which a student had received when he passed out into actual work, nor any guarantee of a subsequent career. These points require brief explanation.

Although the Admiralty so fully recognised the value of scientific training for its naval architects, and made provision for it, yet for half a century they maintained regulations which necessitated the first entry into the service being made either as an apprentice or as a working man. A few exceptions may be quoted : but the general rule was as stated. The result of this arrangement was that, with few exceptions, candidates for entry came from the working classes ; and there was no attraction into the service of the sons of persons in good social positions, such as very commonly become pupils of civil or mechanical engineers. This was obviously a matter which required alteration. The competition for entry was absolutely free, no doubt ; but it was surrounded by conditions which

made the real field of selection narrow, and did away with many possibilities of attracting well-educated youths into the service.

Competition was of the essence of the whole system—unlimited and fierce. There was an open competition for entry as apprentice, with probably ten times as many candidates as there were appointments; then from amongst each year's successful candidates—perhaps thirty or forty in number—three only could reach the Naval College after five or six years' work and frequent examinations. Supposing the College course successfully passed, and the student launched on his professional career as a fully certificated naval architect, he then only began a fresh series of competitive examinations on the result of which depended his future promotion. This was a second objection to the old scheme: it was much the same as if a wrangler were called upon to begin work as teacher in an elementary school, and to compete for that position in elementary subjects with men who knew little or nothing beyond those subjects.

Both these objections have been disposed of by the constitution of the Constructive Corps. For the future, while the apprentices in the dockyards will still retain the possibility of advancement to the highest posts, a new class is to be created, termed "Students of Naval Construction." Not more than three are to be entered annually by open competitive examination; they will receive special training at Portsmouth for six years in both professional and educational subjects, living meanwhile in quarters there, and receiving the same treatment as is given to the students in course of training as engineer officers of the Royal Navy. No possible objection need be felt by any gentleman in placing his son under these conditions, and the training is certain to be thorough. Once entered at the Training School, a student has a definite career before him, provided he is well behaved and diligent. He has simply to pass certain standards to insure entrance into the Naval College; and similar conditions hold good during his stay there, as well as at his graduation therefrom. Very properly, powerful inducements are offered to the students in order that they may exert themselves and pass out in the highest class; but those who pass the standard fixed are to receive appointments at once as Assistant Constructors in the Royal Navy. With position thus assured to begin with, and with duties to perform suited to the special training received, the graduates of the Naval College can look forward to an honourable and useful career in the Constructive Corps. Promotion throughout the subsequent stages is to be by selection, and not by competition, selection being governed by the reputations which men make in their professional work.

There are many degrees of rank in the new corps, reaching up from the junior assistant constructors, to constructors, chief constructors, and the highest office—that of Director of Naval Construction, now so worthily filled by Mr. Barnaby. But from the highest to the lowest all the members of the corps have recognised positions in due relation to one another. This is a great gain.

Still another notable feature in the new arrangements is the possibility which now exists for a naval architect who has obtained his training outside the Admiralty service to enter it after he has proved his capabilities for the appointment of assistant constructor by passing a test examination at the Royal Naval College. There are certain limits of age laid down, and it is possible that the number of candidates who will present themselves for some time to come will not be great. At the same time the Admiralty have shown a wise discretion in thus extending the field from which their shipbuilding officers may be recruited. The private trade has drawn largely hitherto from the Admiralty staff: perhaps some return will be made in future.

In the Constructive Corps are included all the principal

officers at the Admiralty and in the Royal dockyards, and all the specially educated men from the Naval College who have been successful in their course of study. Provision is also made for admission to the corps of subordinate shipwright officers from the dockyards who may be qualified for the appointment. This is a matter of less public interest than those above mentioned, but it has a very important bearing on the discipline and smooth working of the dockyards.

These are the main features of the new arrangements. They promise well for the future. While retaining for the apprentice class their possibilities of advancement to the highest positions, the Admiralty have greatly enlarged the field of selection for their constructive staff, and made it possible for any gentleman to place his son in the Training School at Portsmouth with the assurance that the surroundings will be as suitable as the system of training is excellent. Further, the Admiralty have recognised the wisdom of training men who from the first shall take rank as officers, and not be compulsorily forced through the grade of workman in order to become officers. This is what is done in all the principal foreign navies and in private establishments: it need not involve any loss of practical knowledge of details, and it is a gain from an administrative point of view.

For my present purpose it will suffice to terminate here this sketch of a "new departure" which promises well for the Royal Navy, and to which most people will wish entire success. There are matters of detail which seem open to criticism, and it would be interesting, did space permit, to show in what respects the new regulations resemble or differ from the corresponding regulations in force in the French or other foreign navies. As this could not be done within the limits of this paper, I have been content to draw attention to the openings which the Admiralty have presented to youths who have a taste for naval architecture, but who would not submit to the drudgery of an ordinary apprenticeship; and have endeavoured to point out how the public service may be benefited by the changes introduced.

The shipbuilding profession has hitherto been a very "close" one, both in the public service and outside it. But it may be reasonably anticipated that, at least in the Royal Navy and possibly in private establishments also, a change of system would prove advantageous. If the conditions for admission and training are made to resemble more closely those holding good in various branches of engineering, there seems no good reason why a larger number of well-educated and intelligent young men should not adopt naval architecture as a profession. The new Constructive Corps has been created on the recommendation of a departmental Committee, of which Sir Thomas Brassey was chairman. The Report of this Committee, as well as the minutes of the evidence taken by them, have been published as a Parliamentary Paper (No. 277 of 1883), and will well repay perusal. It may there be seen that the appointment of the Committee resulted chiefly from action taken by Admiral Sir Houston Stewart, when Controller of the Navy: and it is a matter of great gratification to myself that I had the honour of assisting that distinguished officer in the preparation of the scheme, which was substantially recommended by the Committee for adoption, and has been adopted by the Admiralty. A few years' experience will decide whether or not the benefits anticipated from the changes above described will be realised. Much must depend, no doubt, upon the manner in which the scheme is developed, and the process must be gradual and carefully watched if it is to be successful. But whatever the result may be, nothing but good can come from the changes which enlarge the field of selection for the shipbuilding officers of the Royal Navy, and which unite in one corps all ranks and classes of the constructive staff.

W. H. WHITE